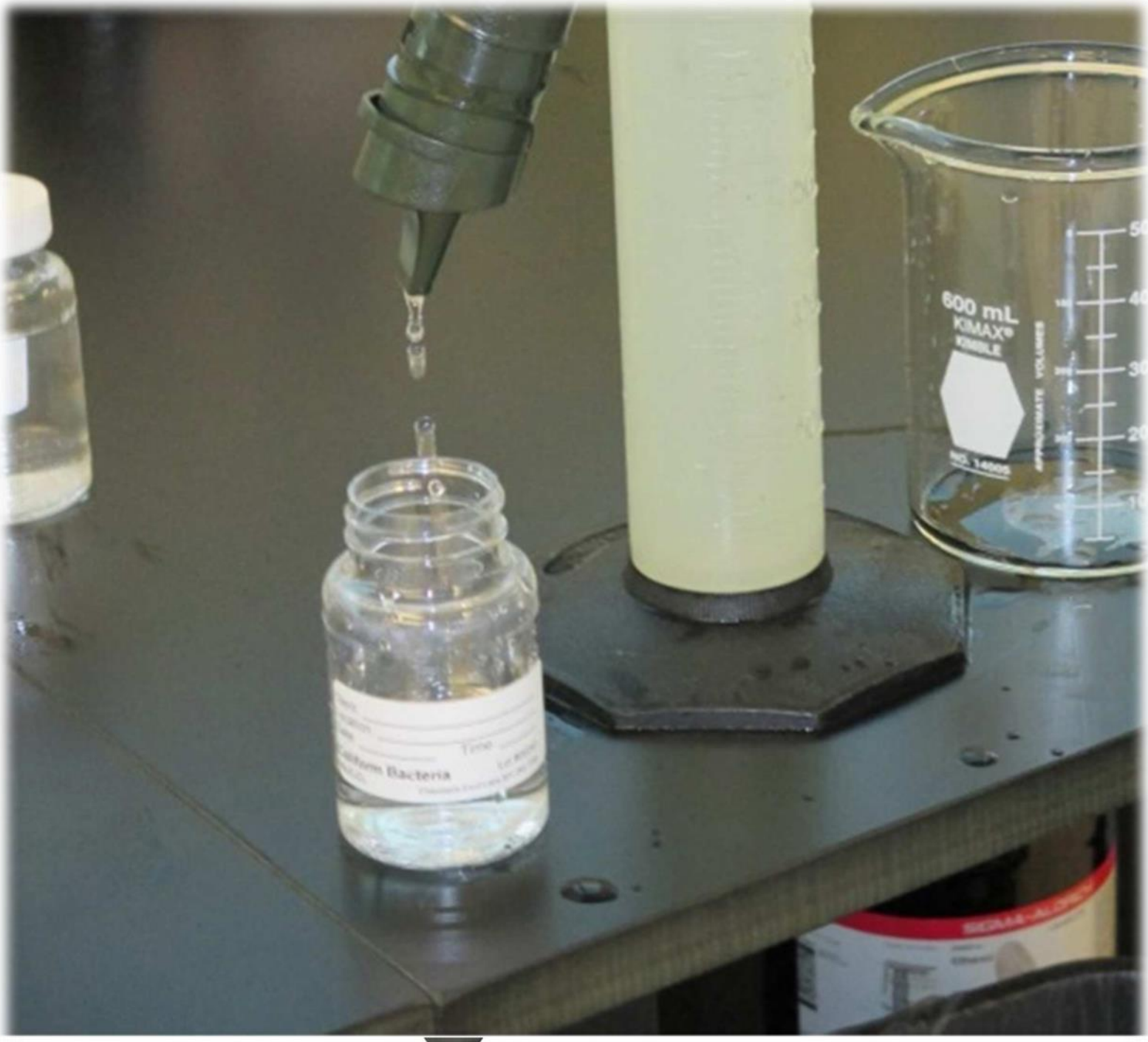

renovo TRIO

Lab Results

Introduction

As a consumer conscious company, Renovo Water wants to provide public testing information of the Renovo Trio. Posting public testing results is not a standard procedure and is not required by any industry regulation. In addition to posting the laboratory results, this report will contain clear explanations of the results and procedures so all may understand the following report.

Purpose of Verification

The purpose of this verification study was to determine the efficacy of the Renovo Trio. These devices were designed to provide safe drinking water in various locations where safe water might not otherwise be available. Areas of concern in drinking water quality included the presence of coliform bacteria, common organic compound contaminants, chlorine residual, and heavy metals.

Renovo Water and associated promotional literature provided claims that these filters provided some degree of safe drinking water for its users. This study was performed by two independent laboratories with no ties or associations with the device manufacturer. The ultimate purpose of the analytical testing was to determine if the filtration system reduced or eliminated the presence of coliform bacteria, organic compounds, chlorine residual, heavy metals and pesticides in appropriate source water.

Laboratory Certifications

Chemtech-Ford Laboratories

Chemtech-Ford Laboratories is certified by the State of Utah under the TNI Standard of NELAC by the Utah State Department of Health for analyses involving drinking water, wastewater, and RCRA standards. Chemtech is also certified by EPA Region 8 to perform drinking water analyses in the State of Wyoming.

A complete list of certifications and methods is located on the Chemtech-Ford website at www.chemtechford.com/resources.html

American West Analytical Laboratories

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Accreditation Program (NELAP) in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, and Missouri.

A complete list of certifications and methods is located on the American West Analytical Laboratories website at http://www.awal-labs.com/AWAL%20Certification.html

***The following report is comprised of excerpts that were taken from two separate reports by Chemtech- Ford and American West Analytical Laboratories to form one aggregate report.**

Background

Development of Test / Quality Assurance Plan

This verification study involved a three stage, hand-held water filtration device. All of the filtration devices used in the verification study were submitted by Renovo Water for testing, and were assumed to be identical for testing purposes.

At the outset, it was important to understand the type of water that would be used by these filtration devices in real-world situations. It was expected that the portable water filters would be used in situations where naturally-occurring surface water (lakes, streams, ponds, and swimming pools) would be employed for drinking.

As a result, it was determined that naturally-occurring water from along the Wasatch Front in Utah could be used as a proxy for water quality used in other world locations. The water from the Jordan River is high in coliform bacteria, suspended solids, and dissolved solids. These are conditions that would be common to many world water sources. The water source was used either as naturally-occurring (for bacterial analysis) or spiked with compounds of interest (for the organics, chlorine and metals analysis).

The compounds of interest and their methodologies are listed below.

1. Bacteriological

Total coliform bacteria and Escherichia coli (E. coli)

Coliform bacteria are commonly prevalent throughout the world, though not all species are associated with human disease. E. coli, a species of fecal coliform bacteria, has long been associated with human disease and is representative of all coliform bacteria that are harmful to human health. The methodology used to analyze for coliform and E. coli is Standard Methods SM 9223B by Colilert Quantitray.

2. Heavy Metals

Lead, Arsenic and Mercury

Renovo Water selected these three metals as being potentially troublesome in foreign water supplies, and as being representative of all such heavy metals. All three metals are common industrial contaminants and are associated with a variety of human health problems. The metals were analyzed by EPA ICP/MS Method 200.8.

3. Organic Compounds

Gasoline and Diesel Range Organics

Naturally-occurring water may be contaminated by volatile (easily evaporated) and semi-volatile organic compounds from various industrial and cleaning industries. The most common contamination sources are fuels such as gasoline and diesel. For this reason, Renovo Water chose to evaluate the performance of the filters with these components. Chemtech-Ford included benzene, ethyl benzene, toluene, total xylenes, and diesel in the test suite. Many of these compounds are carcinogenic and otherwise have been shown to adversely affect human health. The volatile organic compounds (VOCs) were analyzed by EPA GC/MS Method 8260B with detection limits equivalent to drinking water specifications. Diesel analyses were performed using EPA GC method 8015B.

4) Pesticides

Pesticides are a common contaminant in naturally-occurring water. There are many various types of pesticides and chemical compositions. A list of common chemicals was gathered by GC/ECD using method 608.

General Procedure and Test Considerations

To demonstrate the efficacy of the various filtration devices, the concentrations of all the compounds of interest were analyzed before and after the filtration process. For the metals and organic compounds in particular, the compounds were spiked at concentrations which were above the EPA-mandated Maximum Contamination Limits (MCLs), even though this standard may not apply in many real-world applications. The EPA MCL is the highest level of a contaminant that is allowed in drinking water. Some compounds do not have EPA MCLs. This level of spiking allowed easy determination of the reduction in concentration of the levels of the compounds of interest. Because the levels of coliform and E. coli were significantly high in the natural water used, they did not need to be spiked for analysis. The EPA MCL for coliform bacteria in drinking water is zero (none allowed).

It was recognized at the outset that the high suspended solids content of natural water would most certainly clog the filtration devices eventually. This condition would lead to reduced filtration efficiency over time. However, it was agreed before the verification study began that the study was not designed to measure the duration of filtration integrity. Accordingly, the filters were tested as they would be used in a real-world situation, potential limitations and all.

There were other areas of concern to be addressed throughout the study. Because of the nature of volatile organic compounds, it was inevitable that during the course of testing that some volatile compounds would be lost. Special care was taken during the study to assist in minimizing the loss of such volatile compounds (including separate VOC control “blanks”). It should be realized, however, that in the real world, the presence of the same compounds in water used for drinking would also be lost during routine use. Finally, it was realized that there were other variables which might affect the outcome of analytical testing, including the contributions of water chemistry (water hardness, alkalinity, and pH). These will obviously vary throughout the world. By using water source from the Jordan River, Renovo Water hoped to mitigate this variability in the study.

To determine the consistency and reproducibility of use and analysis, all chemical and bacteriological testing was performed in duplicate. E. Quality Assurance the analytical quality

assurance procedures for each test are contained within the Standard Operating Procedure (SOP) documentation for each test.

The tests were performed in duplicate to evaluate precision. Commercially prepared standards were analyzed in conjunction with each test to evaluate accuracy. The frequency and acceptance criteria are contained in the SOP for each procedure.

Testing

System Specifications

The following technical specifications were taken from the Renovo website at: http://www.renovowater.com

"The Renovo Trio was designed to be used in the harshest environments to deliver clean drinkable water. Every aspect about the Trio is over-engineered and rigorously tested. The materials, technology, and even packaging have been designed to deliver superior performance when situations demand it. The goal of the Renovo Water is simple, to provide affordable access to the greatest water filtration possible. The Renovo Trio is the solution. It utilizes a three stage filter design that eliminates more pathogens and chemicals than other leading filters."

Water Production Rates

"1000 Liters"

System Limitations

Designed for individual use.

Technology Claims

Filter pore size – 0.05 micron

Removes Protozoa, Bacteria

Reduces Viruses, Heavy Metals, Chemicals (Lead, Chlorine, Arsenic, etc.)

Test Procedures

The testing was split into groups due to the issues with incompatibility of the sample spikes that were used. The bacterial testing was performed first, followed by the metals testing, and then followed by the organics, pesticides, and chlorine testing. Each testing group followed the same procedures outlined below.

A. *Filter Receipt*

The bottles were received at the laboratory in new condition, in a sealed container. No assembly was required. User documentation was supplied with the filters in each package.

B. *System Decontamination*

Since each filter arrived in a separate sealed package, no decontamination was performed prior to testing.

C. *Filter Identification*

Each filter was inscribed with a number for identification purposes.

D. *Filter Use During Testing*

A new filter was selected for each of the phases of the test. In other words, a new filter was used for the microbiological testing. A new filter was used for metals testing and so on.

E. *Blank Sampling*

A volume of 100 mL of DI water was passed through the filter after it had been wetted. The sample was collected for analysis. The sample was labeled with the corresponding filter number and noted as a blank.

F. *Sample Introduction*

Water used in the testing procedures was loaded into the filter by using a plastic liter bottle and screwing the sample bottle onto the bottom of the filter using the built-in threaded component.

G. *Conditioning*

All filters were wetted by passing 400 mL of deionized (DI) water through the filter. This water was discarded.

Analytical Methods

1. Microbiology

Microbiological testing was performed using Standard Methods 9223B, 20thEdition. Enumeration of coliform and E. coli was conducted using Colilert Quantitrays.

2. Metals

Metals testing was performed using USEPA Method 200.8, ICP/MS.

3. Organics

Organic compound testing was performed using USEPA GC/MS Method 8260B and USEPA Method 8015B.

4. Pesticides

Pesticide testing was performed using GC/ECD Method 608.

Jordan River

The raw water sources were tested to determine the bacterial count and basic water chemistry. The results of the initial testing are included below.

Jordan River Water (Utah)

Conductivity 1960 µmhos/cm

Turbidity 3 NTU

Total Coliforms 1200 organisms (org)/100 mL

E. Coli 20 organisms (org)/100 mL

Results and Discussion

Data

Using the procedures previously outlined the filter was tested and the following are the raw data results. With respect to microbiology results, each value is an integral number and a reading on <1 means no detection.

A. Microbiology Results

Work Order 142889	**Total Coliform**	**E. Coli**
EPA Drinking MCL	<1	<1
Run A DI Water Blank	<1	<1
Run A Jordan River Water Raw	1200	19
Run A Jordan River Water **Filtered**	1**	<1*
Run B DI Water Blank	<1	<1
Run B Jordan River Water Raw	1000	20
Run B Jordan River Water **Filtered**	<1*	<1*

**No detection*

***Refer to Results Section*

B. Metals Results

Work Order 1404599	**Detection mg/L**
Lead	<0.00200*
Arsenics	<0.00332*
Mercury	<0.000150*

**No detection.*

C. Diesel Range Organic Results

Work Order 1402892	**DRO**
EPA Suggested Drinking Water Limit	NA
Run a DI Water Blank	<0.24
Run A Spiked Jordan River Water Unfiltered	1.08
Run A Spiked Jordan River Water **Filtered**	<0.24*
Run B Spiked Jordan River Water Unfiltered	0.94
Run B Spiked Jordan River Water **Filtered**	<0.24*

**No detection*

D. Gasoline Range Organic Results

Work Order 14028952	Gasoline Range Organics
EPA Suggested Drinking Water Limit	NA
Open Bench Spiked Sample Begin	1.08
Open Bench Spiked Sample End	1.02
Run A DI Water Blank	<0.2
Run A Spiked Jordan River Water Unfiltered	1.0
Run A Spiked Jordan River Water **Filtered**	<0.2*
Run B Spiked Jordan River Water Unfiltered	0.94
Run B Spiked Jordan River Water **Filtered**	<0.2*

**No detection*

E. Pesticide Results

Compound	**Reporting Limit**	**Analytical Result**
4,4'-DDD	0.0200	<0.0200*
4,4'- DDE	0.0200	<0.0200*
4,4'-DDT	0.0200	<0.0200*
Aldrin	0.0200	<0.0200*
Alpha-BHC	0.0200	<0.0200*
Chlordane, total	0.200	<0.200*
Delta-BHC	0.0200	<0.0200*
Dieldrin	0.0200	<0.0200*
Endosulfan I	0.0200	<0.0200*
Endosulfan II	0.0200	<0.0200*
Endrin	0.0200	<0.0200*
Endrin Aldehyde	0.0200	<0.0200*
Gamma-BHC	0.0200	<0.0200*
Heptachlor	0.0200	<0.0200*
Heptachlor Epoxide	0.0200	<0.0200*
Toxaphene	0.250	<0.250*

**No detection*

Results

Based on the findings of the testing performed in this study, we can examine the manufacturer's claims.

Claim 1 – Filter pore size of 0.05 micron

Chemtech and AWAL did not evaluate this claim.

Claim 2 – Removes Protozoa and Bacteria

Chemtech evaluated the reduction of bacteria using Total Coliform and E. coli specifically. The filter did remove the bacteria from the test waters. The filtrate of Run A contained a single bacterium. Total coliform bacteria are very common in the natural environment, and the finding in Run A could possibly have been caused by contamination from bacteria on the external portion of the filter spout. The filtrate of Run B was bacteria free.

Claim 3 – Reduces Viruses, Heavy Metals, Chemicals, Pesticides (Lead, Chlorine, Arsenic, etc.)

1. Chemtech or AWAL did not evaluate the ability of the filter with viruses.

2. AWAL evaluated the reduction of Arsenic, Lead, and Mercury in simulated contaminated water. The filter did remove the metals to US EPA drinking water standards.

3. The filter did reduce the amount of chlorine. The US EPA does not have a maximum contaminant level (MCL) for diesel. The filter removed the diesel below the detection limit of the testing equipment. The filter removed the gasoline components below US EPA drinking water limits. The filter removed pesticides components below US EPA drinking water limits.

APPENDIX

A. Abbreviations and Acronyms

°C Degrees Celsius

°F Degrees Fahrenheit

DI Deionized Water

DWS Drinking Water System

EPA Environmental Protection Agency

L Liter

MCL Maximum Contamination Limit

mg Milligram

mg/L Milligrams per Liter (Parts per Million)

mL Milliliter

NELAP National Environmental Laboratory Accreditation Program (TNI)

org Organisms

POU Point-of-Use

QA Quality Assurance

QA/QC Quality Assurance/Quality Control

RPD Relative Percent Difference

SOP Standard Operating Procedure

TNI The NELAC Institute

µg Microgram

µg/L Micrograms per Liter (Parts per Billion)

µg/mL Micrograms per Milliliter (Parts per Million)

µmho Micromho

USEPA U.S. Environmental Protection Agency